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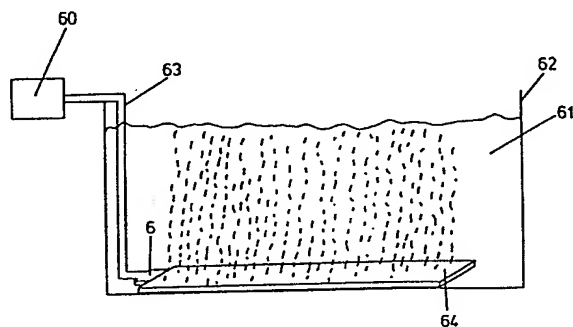
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⑤④ **Diffusor and methods of using the same.**

⑤⑦ A diffusor intended for the throughpassage of a fluid comprises a plate having a multitude of channels which extend therethrough in a mutually parallel relationship. The channels are closed at one of their ends and are connected to a connecting member at the other one of their ends. The plate is provided on one side thereof with a permeable wall for the throughpassage of the fluid.



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BACKGROUND OF THE INVENTION

5 The present invention relates to a new and improved
diffusor for the throughpassage of a fluid medium
and methods of using the same.

10 Diffusors of this type serve to achieve the most
uniform possible distribution of fluid media like
gases or liquids and can be utilized for most
various purposes.

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SUMMARY OF THE INVENTION

20 It is a primary object of the present invention to
provide a new and improved diffusor for the
throughpassage of a fluid medium and which can be
produced in the simplest possible manner for the
most various purposes of use.

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Another and more specific object of the present
invention is directed to the provision of a new and
improved diffusor for the throughpassage of a fluid
medium and which enables a particularly uniform
distribution of the fluid over large surface areas.

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Now in order to implement these and still further
objects of the invention, which will become more
readily apparent as the description proceeds, the
diffusor of the present development is manifested
by the features that, the diffusor comprises a
35 plate-like structure defining two opposite side

1 walls, a multitude of channels extending through
the plate-like structure in a mutually
substantially parallel relationship between the two
opposite side walls and at least one communicating
5 member communicating with the multitude of
channels. A substantial portion of one of the two
opposite side walls constitutes a permeable side
wall and such permeable side wall substantially
covers the multitude of channels on the side of the
10 one side wall.

Advantageously the plate or plate-like structure of
the diffuser according to the invention is made
permeable by providing a multitude of holes or
15 slots which are regularly arranged in a mutually
spaced relationship and which communicate with the
channels, in the side or side wall on one side of
the plate. Such side wall can also be made of an
open porous cell structure to produce the desired
20 fluid permeability. In order to obtain a uniform
pressure drop over the entire area of the inventive
diffuser, the permeability preferably increases
proportionally with the distance from the
connecting member.

25 In a modification for drainage purposes the
aforementioned permeable plate of the diffuser
according to the invention may further comprise a
water-permeable layer.

30 Another variant of the inventive diffuser is
equipped with a further connecting member
permitting a series-arrangement of such diffusers.

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1 According to the invention an apparatus for the gas
treatment of a liquid comprises a source of
pressurized gas which produces a pulsating flow of
the gas and further comprises means arranged in a
5 body of the liquid and connected to this source of
pressurized gas in order to generate a stream of
fine bubbles rising in the body of liquid.

The means for generating the stream of fine bubbles
10 rising in the body of liquid are constituted by any
suitable conventional means like, for example, a
filter member made of porous sintered material or
similar devices. Preferably such means are
constituted by a diffusor of the type mentioned
15 hereinbefore which comprises a plate-like structure
defining two opposite side walls, a multitude of
channels extending through the plate-like structure
in a mutually substantially parallel relationship
between the two opposite side walls and at least
20 one communicating member communicating with the
multitude of channels. A substantial portion of one
of the two opposite side walls constitutes a
permeable side wall substantially covering the
multitude of channels.

25 The diffusors also can be used in accordance with
the invention for uniform gas introduction into
liquids, for example, for the aeration of water,
also of natural waters. They can be generally used
30 at an advantage for the ventilation or aeration of
rooms and specifically for gassing drying chambers
in which farm products like fruits or tobacco are
stored, and they can be beneficially employed in
the process of cheese ripening.

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1 Depending on the related purpose of use, the
diffusor can be connected to a pressure source or
to a vacuum source which, if desired, may comprise
a pulsating pressure source or vacuum source in
5 order to carry out the gassing operation.

Preferably, for the gassing of liquids, weighting
agents like metals or minerals can be added to the
material from which the diffusor is made prior to
10 or after the extrusion in order to increase its
weight so that such diffusors may sink in water.

An advantageous method according to the invention
for using the aforementioned diffusor comprises the
15 steps of arranging the diffusor at a surface and
connecting the diffusor to a source of pressurized
gas. In this manner any friction which exists
between the surface and its environment can be
significantly reduced. This is of particular
20 importance in connection with the hull of a ship
since the friction between the ship's hull and the
water thus can be considerably reduced whereby
energy can be saved or better propulsion
performance can be achieved.

25 The inventive diffusor can be used for drawing-off
or draining purposes, for example, in the ground in
combination with water-pervious fabric or paper.

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BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects
other than those set forth above will become
35 apparent when consideration is given to the

1 following detailed description thereof. Such
description makes reference to the annexed drawings
wherein generally the same reference characters
have been used to denote the same or analogous
5 components and wherein:

Figure 1a shows a cross-section through a
diffusor according to the invention;

10 Figure 1b is a plan view of a longitudinal
section through the diffusor shown in Figure 1a;

Figure 1c shows a top plan view of the diffusor
shown in Figure 1b and illustrates different
structures for providing fluid permeability on one
15 side thereof;

Figure 1d shows a top plan view of the diffusor
shown in Figure 1b and illustrates a diffusor
provided with a regular arrangement of
20 gas-permeable regions;

Figure 2 to 5 illustrate different steps in a
process of providing the diffusor shown in Figure 1
with a connecting member;

25 Figure 6 is a view of part of a further
embodiment of the inventive diffusor provided with
a modified arrangement of the connecting member;

30 Figure 7 is a partial view of another
embodiment of the inventive diffusor provided with
a different arrangement of the connecting member;

35 Figure 8 is a cross-sectional view of a
rectangular slot in the side wall of the diffusor
shown in Figure 1c and illustrates the restoring
process occurring therein;

1 Figure 9 schematically illustrates a still
further embodiment of the diffuser provided with a
further connecting member for series-connection;

5 Figure 10 is a schematic cross-sectional
illustration of a diffuser for ultrafiltration
according the invention;

10 Figure 11 shows a schematic cross-sectional
view of a diffuser for draining purposes according
to the invention; and

15 Figure 12 is a schematic illustration of a
gas-treatment installation according to the
invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 Describing now the drawings, it is to be understood
that only enough of the structure of the diffuser
has been shown as needed for those skilled in the
art to readily understand the underlying principles
25 and concepts of the present development, while
simplifying the showing of the drawings. Turning
attention now specifically to Figure 1a, there has
been shown a cross-section of the inventive
diffuser comprising a plate-like structure or plate
30 1 which has two opposite sides or side walls 7,7'
and through which there extends a multitude of
mutually substantially parallel channels or
passages 2. The latter are separated by partitions
or walls 3 and run substantially parallel to the
35 sides or side walls 7,7'. There is provided at the

1 plate-like structure or plate 1 a connecting member
6 which is structured for connection to a fluid
line which may be a hose, a pipe, or any other kind
of fluid-conducting conduit means. The plate-like
5 structure or plate 1 is also provided at one end
thereof with a communicating space 6' which is in
communication on a first side 5 with the multitude
of channels or passages 2 and which is in
communication on a second side 6'' opposite the
10 first side 5 with the connecting member 6. The two
sides 5,6'' extend substantially transversely
relative to the multitude of channels or passages
2. At the end remote from the communicating space
6' the plate-like structure or plate 1 and thus the
15 multitude of channels or passages 2 is sealed or
closed by a sealed or closed edge 4 extending
transversely to the multitude of channels or
passages 2.

20 The plate-like structure or plate 1 is made of a
suitable plastic or rubber material and is produced
by an extrusion process (Reifenhäuser GmbH
Maschinenfabrik, Troisdorf; W.-Germany). The
production of the connecting member 6 will be
25 explained in detail hereinafter with reference to
Figures 2 to 7 of the drawings.

Figure 1c is a top plan view of the inventive
diffusor and serves to schematically illustrate the
30 general type of passage openings 8 by which the
related side or side wall 7,7' of the plate-like
structure or plate 1 can be made permeable for
fluids which enter the diffusor through the
connecting member 6. The partitions or walls 3 are
35 also indicated in Figure 1c. The entirety or at

1 least a substantial portion of the side or side
wall 7 or 7' of the plate-like structure or plate 1
can be provided with one type or different types of
the permeability-causing passage openings 8
5 illustrated in Figure 1c. The passage openings 8
are disposed such as to communicate with the
channels or passages 2. There is provided a
multitude of such passage openings 8 which are
regularly arranged in a mutually spaced
10 relationship.

As shown on the left-hand side of Figure 1c, the
passage openings 8 may comprise a multitude of very
fine holes 8' or a smaller number of somewhat
15 greater holes 8''. The holes 8', 8'' are arranged
along the channels or passages 2 and can be formed
in the side or side wall 7 of the plate-like
structure or plate 1 by any conventional operation
like, for example, by punching, piercing, boring or
20 burning. Particularly fine holes 8' are obtained by
using fine needles each of which has a diameter of
about 0,5 mm for piercing the related side or side
wall 7, 7'. Due to the restoring capacity of the
material of which the plate-like structure or plate
25 1 is made, the resulting holes 8' only have
diameters in the range of 0,3 mm. The restoring
process occurs in the course of time but can be
accelerated by an annealing action under the
influence of heat. In this manner holes 8' of
30 diameters in the range of 0,05 mm can be produced
in the related side or side wall of 1 mm thickness.

The holes 8', 8'' can be produced in such a manner
as to have a constant cross-section or diameter
35 throughout their length. However, the holes 8', 8''

1 may also widen, for example, in a conical shape in
a direction towards the exterior of the plate-like
structure or plate 1 whereby such holes become less
readily obstructed.

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In the variant shown at the center of Figure 1c the
passage means 8 comprise a multitude of holes 8''
formed in a generally oblong shape.

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In the modification shown on the right-hand side of
Figure 1c the passage openings 8 comprise a
multitude of slots 8'''. The slots 8''' are
formed using conventional tools and may extend in a
lengthwise direction of the related channel or
15 passage 2 as shown but may also extend in a
crosswise relationship thereto. As further shown,
the passage openings 8 may also comprise a
multitude of intercrossing slots 8^V. The slots
8''', 8^V illustrated in Figure 1c have a basically
20 rectangular shape; however, the slots may also
assume any other shape which is suited to produce
the desired permeability in the related side or
side wall 7,7' of the plate-like structure or plate
1.

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The restoring capacity of the material of which the
plate 1 is made can also be utilized for the
formation of fine holes which is illustrated in
Figure 8. There are shown in Figure 8 the original
30 perimeter 9 of a rectangular slot punched into the
related side or side wall 7,7' of the plate-like
structure or plate 1 in the region of a channel or
passage 2. Due to the restoring process, the slot
becomes constricted by material which flows into

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1 the slot from the two opposite long sides. The flow
is stopped when the materials emerging from the two
sides contact each other. While the originally
formed slot is then closed at the contact location
5 9', there remain two very fine holes 10 in the
region of the two small sides of the original
rectangular slot. As already noted hereinbefore,
the restoring process, although proceeding in the
course of time at ambient temperature, can be
10 furthered by an annealing-like action at higher
temperatures.

In all the aforementioned structures the passage
openings 8 may be configured and arranged such that
15 the permeability of the related side or side wall
7,7' increases proportionally with increasing
distance from the connecting member 6 whereby a
uniform pressure drop can be achieved along the
entire length of the diffuser.

20 There are still other means for generating
fluid-permeability in one side wall 7,7' of the
plate-like structure or plate 1. For example, a
water-soluble material can be added to the material
25 from which the plate 1 is produced by extrusion.
The plate obtained by the extrusion is subjected to
water treatment, whereby the water-soluble material
is dissolved out therefrom so that a
fluid-permeable or open porous cell structure
30 remains.

In a further process for producing a
fluid-permeable plate-like structure or plate 1 a
swelling or expanding agent is added to the
35 material from which the plate 1 is produced either

1 prior or during the extrusion-like process.
Porosity and thus fluid-permeability is thereby
produced in the material of which the plate 1 is
made.

5 Preferably, the open porous cell structure obtained
either by solution treatment or by expansion is
completely sealed on one side of the plate-like
structure. The other side is partially sealed in
10 such a manner that a multitude of gas-permeable
regions 8^{VI} embedded in a sealed structure 8^{VI}
is obtained which are regularly arranged in
mutually spaced relationship. The regions 8^{VI} are
15 rectangularly shaped as illustrated in Figure 1d
but may assume any other appropriate shape. Also,
while each of the regions 8^{VI} may be associated
with one of the channels 2 in the plate-like
structure 1 as shown in Figure 1d, the
20 gas-permeable region 8^{VI}, if desired, may also
extend over more than one such channel 2.

The production or formation of the connecting
member 6 at the plate-like structure or plate 1
will now be explained in detail with reference to
25 Figures 2 to 7 of the drawings. In a first step of
the process the partitions or walls 3 between the
channels or passage 2 are severed or cut at one end
portion 11 of the plate-like structure or plate 1,
for example, by means of a suitable cutting device.
30 The opposite edge 4 is sealed or closed as for
example, by welding. An insert 16 is then inserted
into the end portion 11 and retained in a position
which is generally indicated by reference numeral
17. The insert 16 may be made of any appropriate
35 material like metal or plastic and may either be of
solid or tubular material.

1 The insert 16 may be releasably mounted at a
removable retaining member which may be part of
either the extruder for producing the plate-like
5 structure or plate 1 or of the clamping tool
mentioned hereinafter. The extruder, however, can
also be constructed in such a manner that the
insert 16, which is made of a material compatible
with that of the plate 1, is extruded or injected
into the material of the plate 1.

10 Thereafter a heatable shaping or molding clamping
tool of conventional construction is applied to the
material of the plate-like structure or plate 1 in
the region of the end portion 11 thereof on both
15 sides of the insert 16. Under the action of the
heat and pressure of the clamping tool the material
melts and forms a sealed constriction 18 including
a protruding portion 19 which encloses the insert
16. The end portion 11 forms laterally and inwardly
20 converging ledges 20 during this operation and the
ledges 20 laterally define the constriction 18. The
product of this step is shown in a perspective view
in Figure 3. In the side view of Figure 4 there are
25 recognized the ledges 20 formed in the end portion
11, the constriction 18 with its bottom portion 21
and the protruding portion 19 from which the insert
16 is removed. The tubular portion thus obtained
has an internal passage or bore 22 and constitutes
the connecting member 6. Instead of the solid
30 insert 16 there can also be used a tubular insert
selected from materials which are fixedly connected
and retained by the protruding portion 19 as a
result of the action of the heatable clamping tool
on the end portion 11. If desired, the protruding
35 portion 19 and thus the connecting member 6 can be

1 provided with sealing ribs or other known sealing
elements in order to permit a sealed connection
thereof to the fluid-conducting conduit means.

5 After the formation of the connecting member 6 the
still open edge of the plate-like structure or
plate 1 is sealed or closed across the width of the
plate-like structure or plate 1 so that a
communicating space 23 is formed and bounded by a
10 first side 24 and a second side 6'' which extend
transversely relative to the multitude of channels
or passages 2. The space 23 communicates with the
channels or passages 2 on the first side 24 which
is defined by the depth of severing or cutting of
15 the partitions or walls 3 and with the connecting
member 6 constituted by the protruding portion 19
on the second side 6'' which constitutes a sealed
edge and comprises the ledges 20 and the bottom
portion 21.

20 In a further step the material forming the
constriction 18 between the protruding portion 19
and the ledges 20 can be removed so that a
structure results which is illustrated in Figure 5
and which comprises free spaces 25 between the
25 portion 19 and the ledges 20.

A further embodiment of the inventive diffusor is
shown in part in Figure 6. In this embodiment a
30 continuous, sealed or closed outer edge at the
plate-like structure or plate 1 forms a second side
27 of the communicating space 23 while the
connecting member 6 constitutes a protruding
portion which is structured like the protruding
35 portion 19 described hereinbefore with reference to

1 Figures 2 to 5. The protruding portion 19 is also
produced in an essentially analogous manner and is
provided with two sealing ribs or lips 28,28' which
5 permit a fluid-tight connection to the
fluid-conducting conduit means.

A partial side view of another embodiment of the
inventive diffuser is shown in Figure 7. In this
embodiment the second side of the communicating
10 space 23 can be formed as shown in Figures 2 to 5,
but may also be formed as shown in Figure 6. A
tubular insert 30 is fitted into the internal
passage or bore 22 of the protruding portion 19 and
is fixedly connected thereto by, for example,
15 welding, adhesive bonding or the like. A sealing
rib or lip 31 is formed at the tubular insert 30 so
that a reduced portion 33 is formed between the
sealing rib or lip 31 and the end 32 of the
protruding portion 19. Any conduit means connected
20 to the connecting member thus formed can be secured
by applying thereto a pipe clamp or clip or the
like in the region of the reduced portion 33.

A still further embodiment of the diffuser is
25 schematically illustrated in Figure 9. In this
embodiment there are provided a further
communicating space 37 and a further connecting
member 35 at the plate-like structure or plate 1 at
a location which is remote from the communicating
space 23 or the connecting member 6. The further
30 communicating space 37 is produced in a manner
analogous to the production of the communicating
space 23. It has a first side 38 defined by the
depth of severing or cutting and communicating with
the multitude of channels or passages 2. It has a
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1 second side 39 essentially constituting a sealed
edge and connected to the further connecting member
35 which has a passage or bore 36. While the
5 illustrated embodiment has a structure as shown in
Figure 7, each of the connecting members 6,35 can
have any one of the structures described
hereinbefore and is connectable to any appropriate
fluid-conducting conduit means. Diffusors of this
type can be interconnected in series.

10 The communicating space 23 and/or 37 can also be
provided at the plate-like structure or plate 1 by
welding to either one or both ends thereof, in any
appropriate manner known in the art of plastic
15 material processing, a space or chamber defining
structure. Such structure is provided with a
suitable connecting member of the general kind as
described hereinbefore or the connecting member can
be affixed thereat later.

20 A gas treatment apparatus for the gas treatment of
a liquid generally contains a source of pressurized
gas and means arranged in a body of the liquid and
connected to the source of pressurized gas. In the
25 apparatus according to the invention the source of
pressurized gas is selected of the type which
produces a pulsating flow of gas like, for example,
a twin membrane compressor (Thomas Industries,
Inc., Shebeugan, Wisc.; Type 1502). It has been
30 found that such pulsating flow of the gas results
in a particularly favourable and effective
distribution of the gas in the liquid to be
treated. Any means such as, for example, a filter
member of porous, sintered material which generates
35 a stream of fine rising bubbles may be connected to

1 the source of the pulsating gas flow. In the
specific embodiment illustrated in Figure 12, the
gas treatment apparatus comprises a source 60 which
5 produces a pulsating flow of air and aerates a body
61 of water in a tank or container 62 which is open
at the top. A connecting line or conduit 63
interconnects the source 60 and the connecting
member 6 of a diffuser of the type as illustrated
10 in Figures 1a to 1d and which is generally
designated by the reference numeral 64. The
pulsating gas flow in combination with the regular
arrangement of mutually spaced holes or slots or
permeable regions in the diffuser 64 results in a
15 very efficient aeration of the body 61 of water but
can also be employed, of course, for the treatment
of any other kind of liquid with any appropriate
gas.

20 The different diffusers of the types as described
hereinbefore can be used for a multitudinous
variety of different purposes. The diffuser, for
example, can be utilized for the aeration of water
like the water in fish ponds when connected to a
suitable air source. For this purpose the diffuser
25 is anchored at the bottom of the body of water and
connected to a source of pressurized air by a hose,
a pipe or any other appropriate conduit means. A
specifically favorable bubble distribution can be
obtained when a pulsating air flow is used for the
30 aeration. Such pulsating gas flows can be generated
by, for example, a twin-membrane compressor (Thomas
Industries, Inc., Shebeugan, Wisc.; Type 1502).

35 The material of which the diffuser is made may also
contain a weighting material like metal or mineral

1 which is added thereto either prior to or after the
manufacture of the diffuser and which enables the
diffusers to be laid out at the bottom of a body of
water. The diffusers can also be series-connected
5 when using the embodiment shown in Figure 9. The
aeration in any case is extremely effective and
thus advantageous because there is generated
thereby a stream of finely distributed air bubbles
which rise in a uniform manner from an extended or
10 large surface.

The diffuser can furthermore be employed with
advantage for the uniform gassing or degassing of
rooms or chambers or the like when respectively
15 connected to a suitable source of excess pressure
or vacuum. Such gassing or degassing may be
utilized, for example, for all kinds of air drying
operations but is also particularly useful in the
dairy industry and there specifically in connection
20 with cheese producing operations.

A further and particularly desirable use of the
inventive diffuser is related to gas filtration in
combination with suitable filter means which are
25 placed on the outside of the permeable side or side
wall 7 and/or 7' of the diffuser. Such use is of
high importance for the aeration of confined spaces
such as, for example, shelters of the most
different kinds. Of course, such arrangements are
30 preferably also employed in combination with air
conditioning installations.

The diffusers as described hereinbefore and when
connected to a source of pressurized gas can be
35 used to generate a friction-reducing layer of gas,

1 for example, at the outer wall of the hull of a
ship. A thin film of air can be generated in this
manner between the hull of the ship and the
5 surrounding water which quite considerably reduces
the hull's friction in water and thereby
significantly reduces the energy for the ship's
propulsion. There can thus be achieved either a
reduction in the energy consumption or considerably
10 increased propulsion performance at unaltered
energy consumption.

The diffusors of the type as described hereinbefore
can also be used at an advantage for cooling
15 purposes, for example, in combination with air
conditioning installations for water cooling
purposes as well as for air cooling purposes. The
fine distribution of the respective fluid medium by
such diffusors over a large area or through a large
20 space is specifically beneficial for the effective
heat exchange desired in such installations.

Figure 10 shows a diffuser including a filter layer
40 in a schematic cross-sectional illustration. The
25 diffuser corresponds to any one of the diffusors
illustrated in Figures 1a,b,c,d to 4 but may also
be of the type shown in either one of Figures 5 to
9. The side or side wall 7 of the plate-like
structure or plate 1 is made permeable by any one
30 of the means described hereinbefore with reference
to Figures 1c,ld and 8. The side or sidewall 7 is
covered by a filter layer 40 which is mounted at
the plate-like structure or plate 1 in any suitable
manner by conventional mounting means. Such
35 diffusors are useful for the filtration of gas, for

1 example, for the removal of dust or any particles
contained in a gas.

5 Furthermore, the diffuser illustrated in Figure 10
and containing the filter layer 40 can also be used
for the gas treatment of liquids by connecting the
connecting member 6 thereof to a source of
pressurized gas, particularly to a source of the
10 kind as mentioned with reference to Figure 12 and
which produces a pulsating gas flow. When the
diffuser is placed in the body of liquid to be
treated, there is obtained a stream of rising very
fine gas bubbles during the operation of the source
15 of pressurized gas and such very fine gas bubbles
are favorable for a particularly effective gas
treatment. Interaction between adjacent gas bubbles
can be considerably reduced, if the filter layer 40
is partially sealed in such a manner that a regular
20 arrangement of spaced gas-permeable regions is
formed, i.e. if the filter layer 40 has a structure
which is analogous to the structure of the
gas-permeable sode or side wall of the diffuser
illustrated in Figure 1d.

25 Figure 11 is a schematic cross-sectional view of a
diffuser which is modified for drainage purposes.
Therefor the plate-like structure 1 is provided
with connecting members 6 and 35 as shown in Figure
9 and a number of diffusers are series-connected
30 via the related adjacently located connecting
members; the first connecting member 6 and the last
connecting member 35 are connected to respective
drain lines. However, diffusers of the type
illustrated in Figures 1a,b,c,d to 8 can also be
35 utilized for this purpose; as the case may be,

1 there can either be employed a single,
large-surface diffuser or a number of smaller
diffusers in a separate, spaced arrangement and
each connecting member 6 is connected to a
5 collective drain line.

The plate-like structure or plate 1 is bounded by
two permeable sides or side walls 7,7' although it
may be sufficient to employ diffusers having only
10 one permeable side wall 7 or 7'. The permeability
can be caused by any one of the means described
hereinbefore with reference to Figures 1c and 8.

The permeable side or side wall 7 and/or 7' is
15 covered by a filtering material or filter-web
generally designated by the reference numeral 50
and essentially consisting of a filter web mounted
at the related side wall 7,7'. The filter web may
be made of paper or fabric or any other material
20 suitable as a filtering material and adapted to the
related filtering conditions. The filtering
material 50 is removably mounted at the related
side or side wall 7,7' by a retaining or guiding
structure 51 secured thereto but may also be held
25 at the related side wall 7,7' by any other
conventional holding means. The entire arrangement
is placed in the ground or region to be drained;
conventional drain lines and pumps are connected to
the connecting members of the related diffuser
30 arrangements and are operated in conventional
manner to conduct the draining operation.

While there are shown and described present
preferred embodiments of the invention, it is to be
35 distinctly understood that the invention is not

1 limited thereto, but may be otherwise variously
embodied and practiced within the scope of the
following claims. ACCORDINGLY,

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5 WHAT I CLAIM IS:

1. A diffusor for throughpassage of a fluid medium, comprising:

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a plate-like structure defining two opposite side walls;

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a multitude of channels extending through said plate-like structure in a mutually substantially parallel relationship between said two opposite side walls;

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at least one connecting member communicating with said multitude of channels;

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a substantial portion of one of said two opposite side walls constituting a permeable side wall; and

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2. The diffusor as defined in claim 1, wherein:

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said multitude of channels extends substantially parallel to said one of said two opposite side walls of said plate-like structure.

- 1 3. The diffusor as defined in claim 1, further
including:

5 a communicating space provided at said
plate-like structure and defining a first side
 which extends substantially
transversely relative to said multitude of
channels;

10 said communicating space communicating on
said first side thereof with said multitude of
channels; and

15 said communicating space being provided with
said at least one connecting member.

4. The diffusor as defined in claim 3, wherein:

20 said plate-like structure is provided with a
sealed edge extending transversely relative to
said multitude of channels at a location remote
from said communicating space.

25

5. The diffusor as defined in claim 1, further
including:

30 at least one further connecting member
communicating with said multitude of channels
at a location remote from said at least one
connecting member.

- 35 6. The diffusor as defined in claim 5, further
including:

1 a further communicating space provided at
said plate-like structure at a location remote
from said at least one connecting member;

5 said further communicating space defining a
first side which extends substantially
transversely relative to said multitude of
channels;

10 said further communicating space
communicating on said first side thereof with
said multitude of channels; and

15 said further communicating space being
provided with said at least one further
connecting member.

20 7. The diffuser as defined in claim 1, wherein:

 said permeable side wall has a permeability
which increases proportionally with increasing
distance from said at least one connecting
member.

25

8. The diffuser as defined in claim 1, wherein:

30 said permeable side wall is of a perforated
structure.

9. The diffuser as defined in claim 8, wherein:

35 said perforated structure comprises a

1 multitude of holes regularly arranged in a
mutually spaced relationship.

5 10. The diffuser as defined in claim 9, wherein:

said perforated structure comprises holes of
increasing diameter in an outward direction.

10

11. The diffuser as defined in claim 8, wherein:

said perforated structure comprises a
multitude of slots regularly arranged in a
15 mutually spaced relationship.

12. The diffuser as defined in claim 1, wherein:

20

said permeable side wall comprises a
partially sealed, open porous cell structure
containing a multitude of gas-permeable regions
regularly arranged in a mutually spaced
relationship; and

25

each one of said gas permeable regions
communicating with at least one of said
multitude of channels extending through said
plate-like structure.

30

13. The diffuser as defined in claim 1, wherein:

said plate-like structure comprises a
35 plastic material.

1 14. The diffusor as defined in claim 1, wherein:

said plate-like structure comprises a
rubber-like material.

5 15. The diffusor as defined in claim 1, wherein:

said plate-like structure is provided with a
weighting agent.

10

16. The diffusor as defined in claim 1, further
including:

a filter layer; and

15

said filter layer being mounted at said one
side wall the substantial portion of which
constitutes said permeable wall.

20

17. The Diffusor as defined in claim 16, wherein:

said filter layer is provided with a
multitude of gas-permeable regions regularly
arranged in a mutually spaced relationship.

25

18. An apparatus for the gas-treatment of a liquid,
comprising:

30

a source of pressurized gas generating a
pulsating flow of the pressurized gas;

means arranged in a body of the liquid und

35

1 connected to said source of pressurized gas in
order to generate a stream of fine gas bubbles
rising in said body of liquid.

5

19. The apparatus as defined in claim 18, wherein:

10 said means for generating a stream of fine
bubbles rising in the body of liquid constitute
at least one diffuser arranged in the body of
liquid;

said diffuser comprising:

15 a plate-like structure defining two opposite
side walls;

20 a multitude of channels extending through
said plate-like structure in a mutually
substantially parallel relationship between
said two opposite side walls;

at least one connecting member communicating
with said multitude of channels;

25

a substantial portion of one of said two
opposite side walls constituting a permeable
side wall; and

30 said permeable side wall substantially covering
at least said multitude of channels on the side
of said one side wall.

35 20. A method of introducing a gas into a liquid,

1 said method including the steps of:

 arranging means for generating a stream of
5 rising fine gas bubbles in a body of the
 liquid;

 connecting said bubble generating means to a
 source of pressurized gas which produces a
 pulsating flow of gas; and

10 feeding said pulsating flow of gas through
 said means arranged in said body of liquid in
 order to generate therein said stream of rising
 fine gas bubbles.

15

21. A method of using a diffuser comprising a
 plate-like structure with two opposite side
 walls, a multitude of channels extending
 through said plate-like structure, one of said
20 two side walls being permeable at least in the
 region of said multitude of channels, and at
 least one connecting member, said method
 including the steps of:

25

 arranging at least one such diffuser in a
 body of a liquid;

30

 connecting the at least one connecting
 member of said at least one diffuser to a
 source of pressurized gas; and

35

 passing said pressurized gas through said
 diffuser in order to form a stream of very
 finely distributed gas bubbles and to
 uniformly gas said body of liquid.

1 22. The method as defined in claim 21, wherein:

the step of passing said pressurized gas
through said diffuser includes the step of
5 passing therethrough a pulsating gas flow.

23. The method as defined in claim 21, wherein:

10 the step of passing said pressurized gas
through said diffuser and said body of liquid
includes the step of exchanging heat between
said gas and said liquid.

15

24. A method of using a diffuser comprising a
plate-like structure with two opposite side
walls, a multitude of channels extending
through said plate-like structure, one of said
20 two side walls being permeable at least in the
region of said multitude of channels, and at
least one connecting member, said method
including the steps of:

25 arranging at least one such diffuser in a
confined space;

connecting the at least one connecting
member of said at least one diffuser to a
30 source of superatmospheric or subatmospheric
gas pressure; and

ventilating said confined space by passing a

35

1 flow of said gas through said at least one
diffusor under the action of said
superatmospheric or subatmospheric gas
5 pressure.

5

25. The method as defined in claim 24, wherein:

10 said step of arranging said at least one
diffusor in a confined space includes the step
of arranging said at least one diffusor in a
drying chamber.

15 26. The method as defined in claim 24, wherein:

said step of ventilating said confined space
includes the step of passing a pulsating flow
of gas through said at least one diffusor.

20

27. A method of using a diffusor comprising a
plate-like structure with two opposite side
walls, a multitude of channels extending
25 through said plate-like structure, one of said
two side walls being permeable at least in the
region of said multitude of channels, and at
least one connecting member, said method
including the steps of:

30

arranging at least one such diffusor between
two closely adjacent surfaces;

35

connecting said at least one connecting
member of said at least one diffusor to a

1 source of a pressurized fluid ; and

passing said pressurized fluid through said
at least one diffuser and between said two
5 closely adjacent surfaces in order to reduce
friction therebetween.

28. The method as defined in claim 27, wherein:

10 the step of arranging said at least one
diffuser includes the step of arranging the
same between the hull of a ship and a body of
water in which said hull is immersed.

15

29. A method of using a diffuser comprising a
plate-like structure with two opposite side
walls, a multitude of channels extending
20 through said plate-like structure, one of said
two side walls being permeable at least in the
region of said multitude of channels, and at
least one connecting member, said method
including the steps of:

25

mounting a liquid-pervious filter web at
said one side wall of said diffuser;

30

arranging at least one such diffuser with
said filter web mounted thereat within a liquid
containing body;

35

connecting said at least one connecting
member of said at least one diffuser to a drain
line of drainage means; and

1 passing said liquid through said filter web
and said at least one diffuser under the action
of said drainage means in order to drain said
liquid from said liquid containing body.

5

30. A method of using a diffuser comprising a
plate-like structure with two opposite side
walls, a multitude of channels extending
10 through said plate-like structure, one of said
two side walls being permeable at least in the
region of said multitude of channels, and at
least one connecting member, said method
including the steps of:

15

mounting a filter web at said one side wall
of said diffuser;

20

arranging at least one such diffuser with
said filter web mounted thereat in the
atmosphere of a contaminated gas;

25

connecting said at least one connecting
member of said at least one diffuser to a
vacuum source; and

30

passing said contaminated gas through said
filter web and said at least one diffuser under
the action of said vacuum source in order to
remove the contaminants from said gas.

35

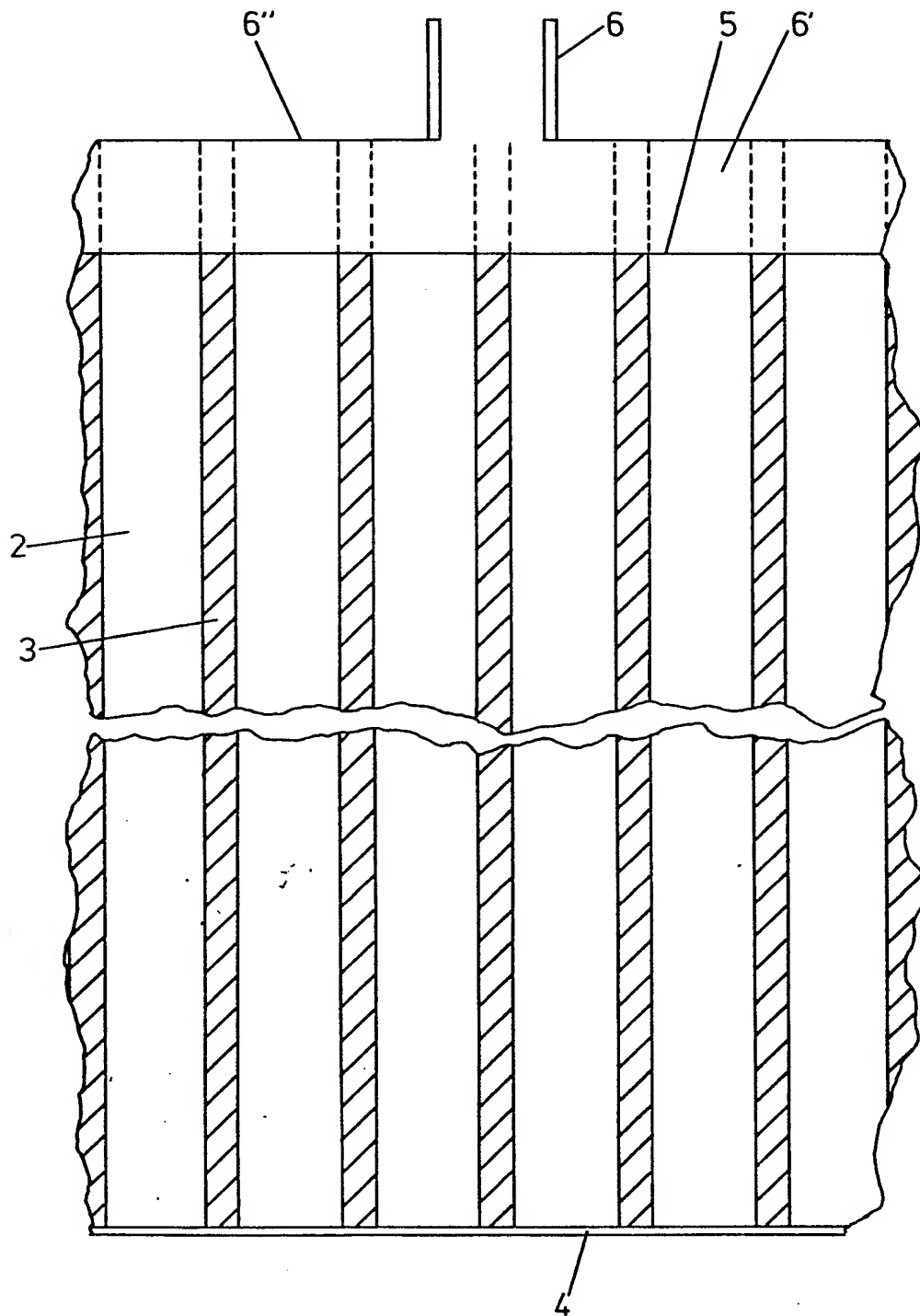


Fig. 1b

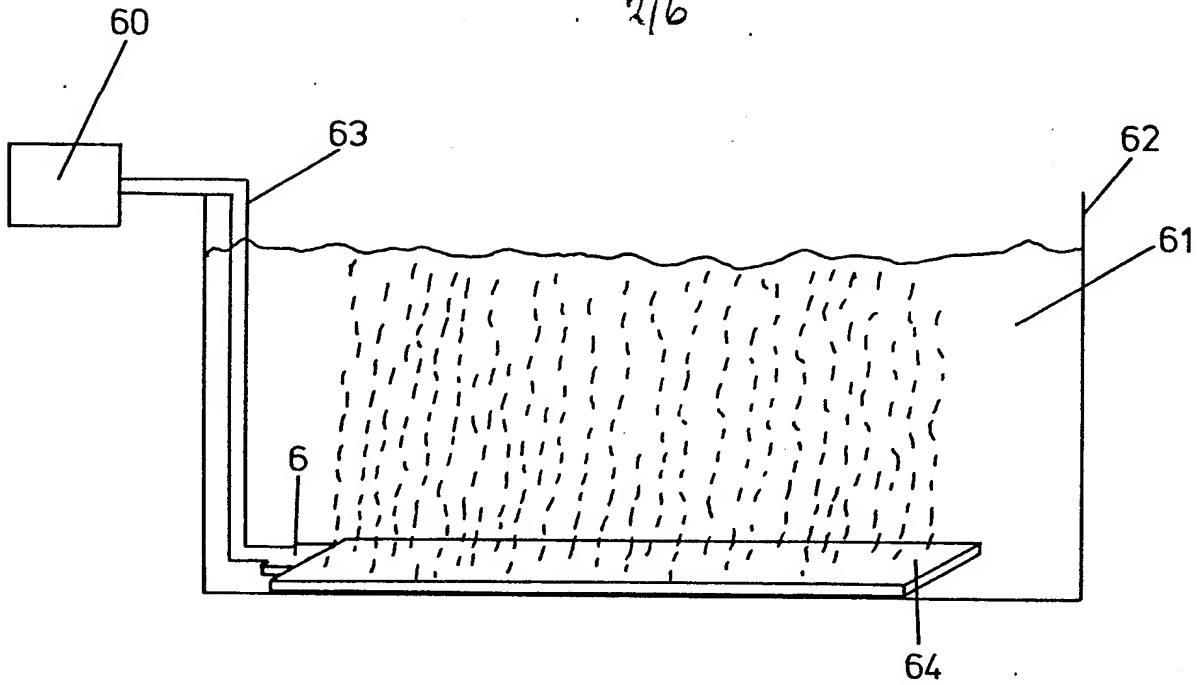


Fig. 12

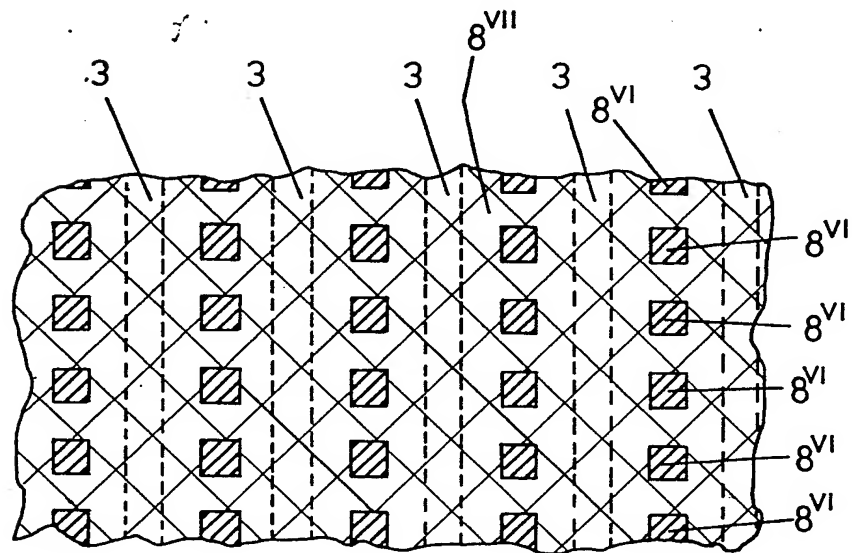


Fig. 1d

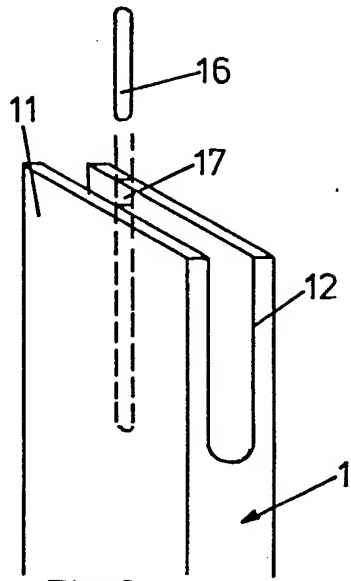


Fig. 2

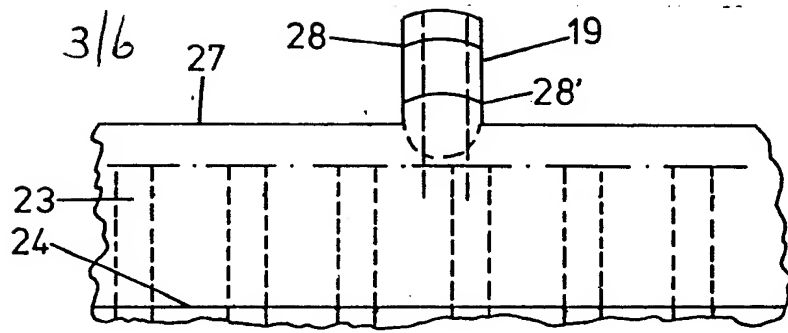


Fig. 6

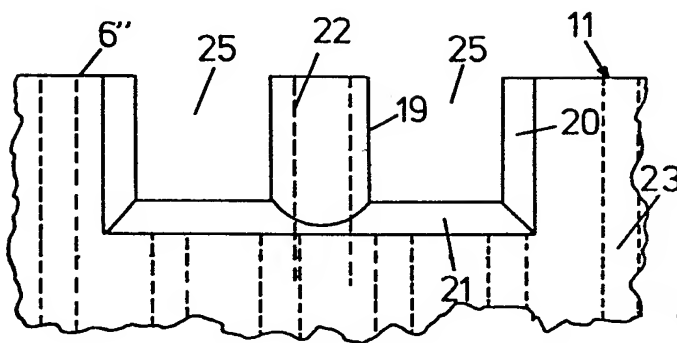


Fig. 5

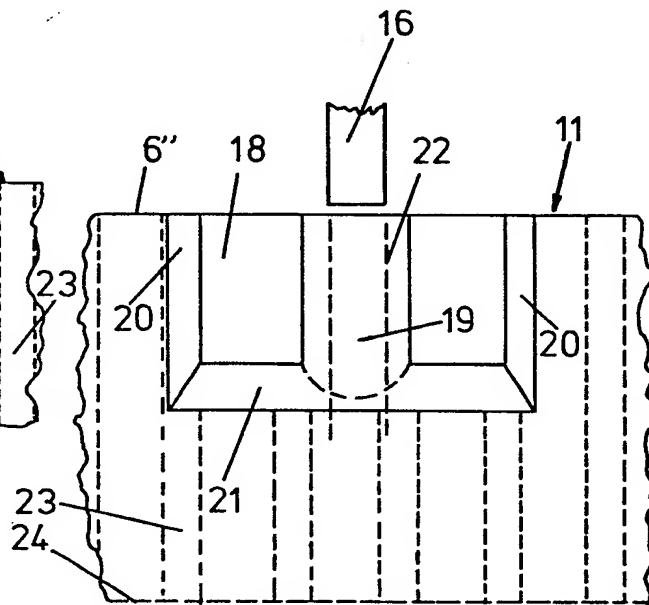


Fig. 4

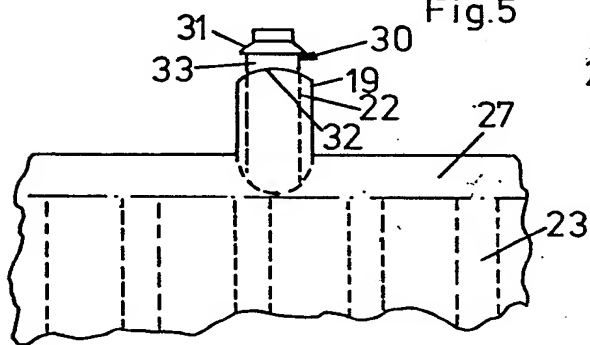


Fig. 7

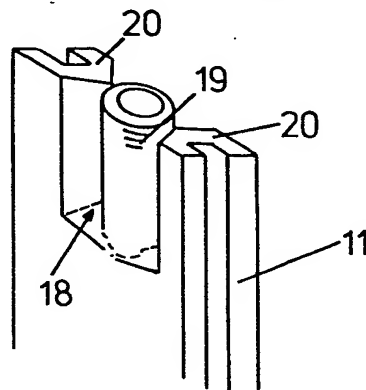


Fig. 3

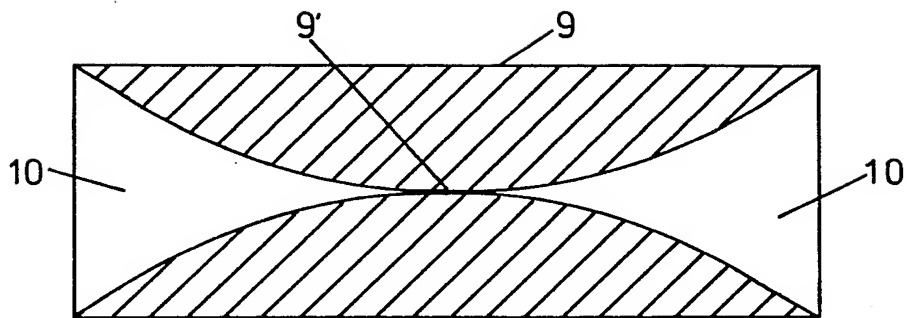


Fig.8

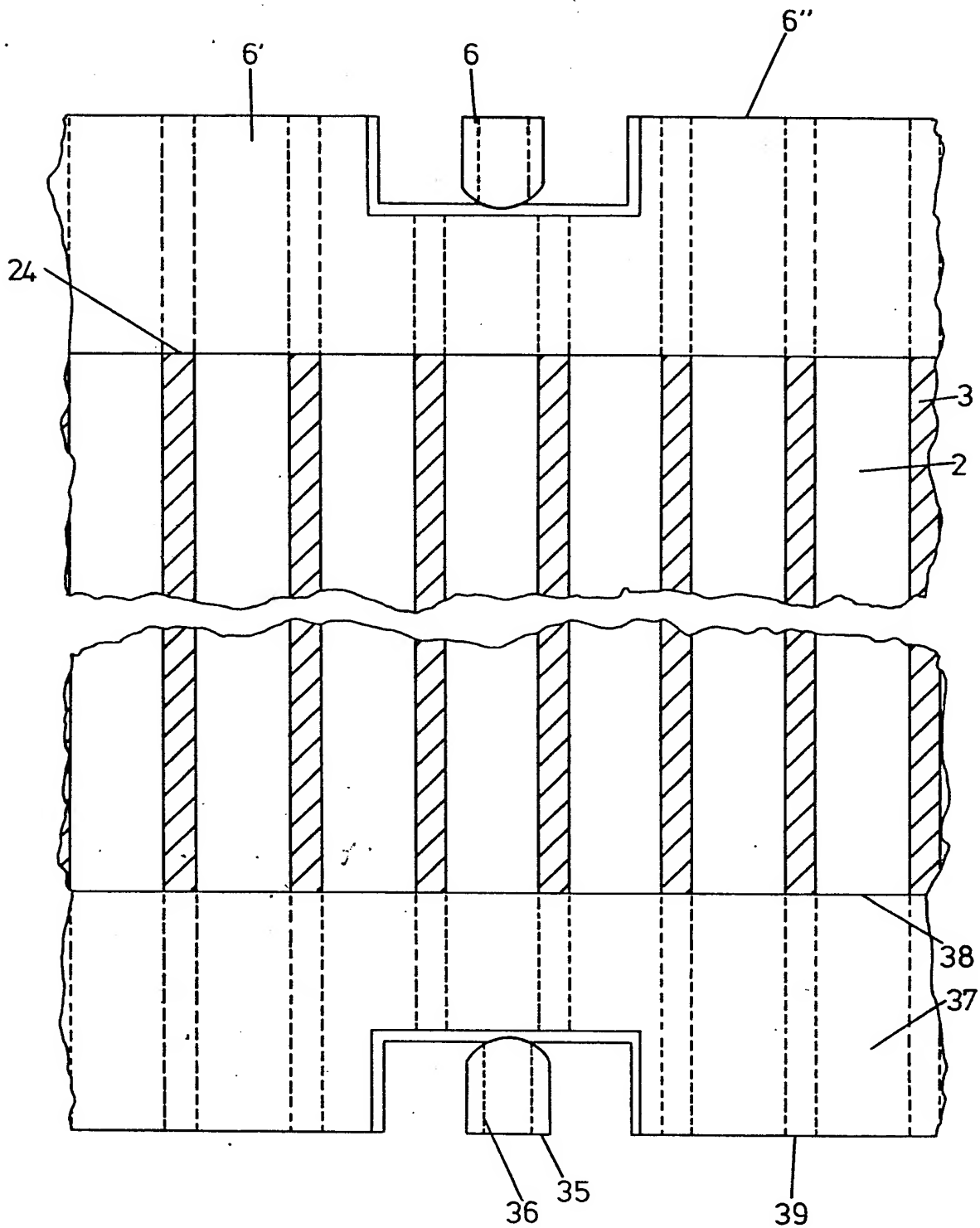


Fig.9

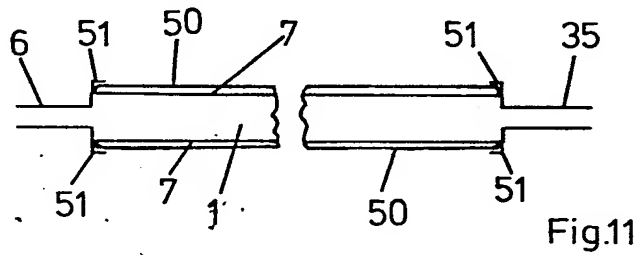
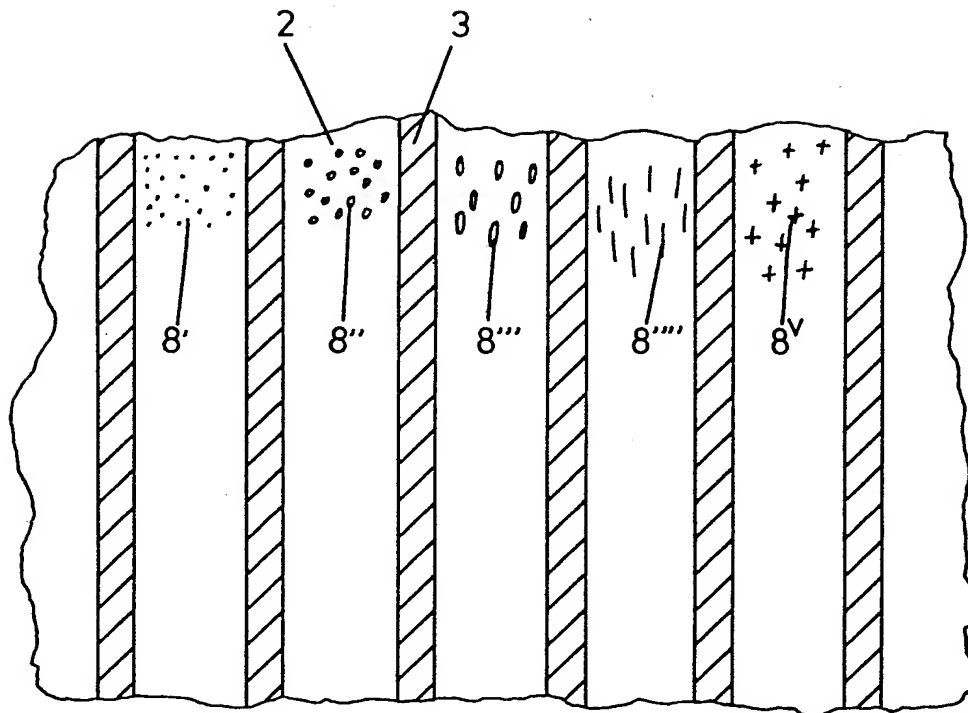


Fig.1c

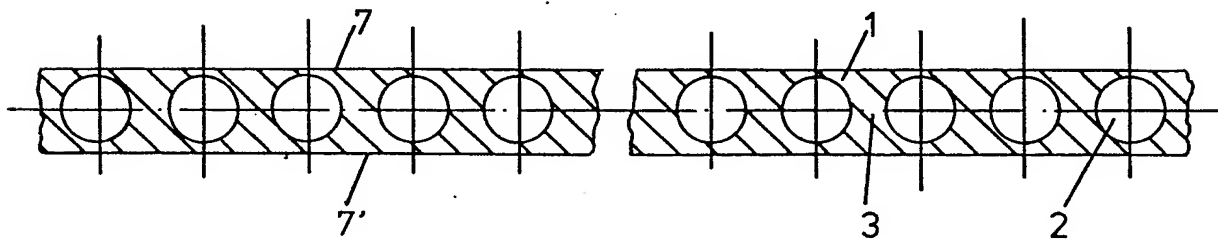


Fig.1a

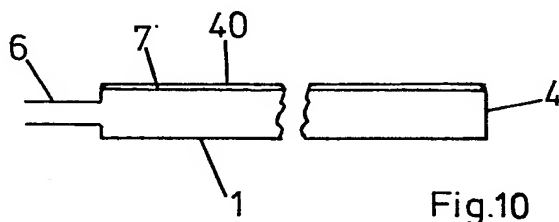


Fig.10